the normal nutrition of *Drosophila* no bacterial action is required.

It will be our next task to attempt to raise the flies aseptically on our artificial culture media, to decide whether or not in our experiments bacteria performed the work of synthesis for the larvæ.

It was natural to raise the question to what extent the nitrogen content of the filter paper contributed to the result. The fact that no larva was able to grow on filter paper, water, sugar and salts alone indicates that the nitrogen content of the filter paper played practically no rôle in the nutrition. Moreover, the amount of N contained in the filter paper was negligible compared with the amount of N added in the form of amino-acid or ammonium salts. One culture contained, as a rule, 200 mg. glycocoll or other amino acid, *i. e.*, roughly between 30 and 40 mg. of nitrogen. The 250 mg. of filter paper added to the culture contained only 0.02 mg. of nitrogen. The nitrogen in the filter paper was therefore about between 1/2,000 and 1/1,500 of the total nitrogen in the culture medium. Nevertheless, it is a fact that in liquid cultures without filter paper—in this case glass beads were used to prevent the drowning of the flies—the yield of larvæ was very much smaller than with filter paper. It should also be stated that the larvæ ate little if any of the filter paper. It will be one of the tasks of our further experiments to find out what caused the difference in the two cases.

Jacques Loeb

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New York

THE BOTANICAL SOCIETY OF AMERICA

The ninth annual meeting of the Botanical Society of America was held in the Medical School of the University of Pennsylvania, Philadelphia, Pa., December 29–31, 1914. The following officers were elected for the ensuing year:

President—John M. Coulter.

Vice-president—R. A. Harper.

Treasurer—Arthur Hollick.

Councilor—W. F. Ganong.

The resignation of George T. Moore as secretary was accepted and Mr. H. H. Bartlett, of the Department of Agriculture, elected to fill the unexpired term.

The council for 1915 will consist of above officers and George P. Atkinson and David Fairchild.

The following botanists were elected to membership: Adeline Ames, Department of Agriculture, Washington, D. C.; E. G. Arzberger, Bureau of Plant Industry, Washington, D. C.; Freda M. Bachmann, Milwaukee Downer College, Milwaukee, Wis.; Samuel M. Bain, University of Tennessee, Knoxville, Tenn.; A. L. Bakke, Ames, Iowa; Henry W. Barre, Clemson College, S. C.; H. P. Barss, Oregon Agric. Coll., Corvallis, Oregon; R. Kent Beattie, Bureau of Plant Industry, Washington, D. C.; Albert T. Bell, University of Louisiana, Baton Rouge, La.; H. M. Benedict, University of Cincinnati, Cincinnati, O.; R. C. Benedict, 2303 New Kirk Ave., Brooklyn, New York; Charles Brooks, Bureau of Plant Industry, Washington, D. C.; E. P. Bicknell, 30 Pine St., New York City; Guy R. Bisbey, Brooklyn Botanic Garden, Brooklyn, N. Y.; Harry P. Brown, 219 Linden Ave., Ithaca, N. Y.; Stewardson Brown, 20 East Penn St., Philadelphia, Penna.; Edward Sandford Burgess, Hunter College, New York City; Gertrude S. Burlingham, 556 Lafayette Ave., Brooklyn, N. Y.; George H. Chapman, Mass. Agric. College, Amherst, Mass.; C. Harvey Crabill, Va. Agr. Exp. Sta., Blacksburg, Va.; Richard O. Cromwell, North Carolina Agric. Exp. Sta., West Raleigh, N. C.; Gilbert Cameron Cunningham, Burlington, Vt.; Charles C. Deam, Bluffton, Indiana; W. W. Eggleston, Dept. of Agriculture, Washington, D. C.; John H. Ehlers, Univ. of Michigan, Ann Arbor, Mich.; Julia T. Emerson, 131 East 66th St., New York City; T. J. Fitzpatrick, Cotner University, Bethany, Nebraska; Eloise Gerry (U. S. Forest Service), 616 Lake St., Madison, Wis.; Melvin R. Gilmore, Neb. His. Soc. Museum, Lincoln, Nebraska; John P. Helyar, New Brunswick, New Jersey; Bascombe Britt Higgins, Georgia Exp. Sta., Experiment, Georgia; H. B. Humphrey, Dept. of Agric., Washington, D. C.; L. M. Hutchins, Bureau Plant Industry, Washington, D. C.; H. S. Jackson, Oregon Agric. College, Corvallis, Oregon; Cyrus A. King, Erasmus Hall High School, Brooklyn, N. Y.; B. F. Lutman, University of Vt., Burlington, Vt.; Fred McAllister, University of Texas, Austin, Texas; Walter B. McDougall, University of Illinois, Urbana, Ills.; S. M. McMurran, Bureau of Plant Industry, Washington, D. C.; K. K. Mackenzie, 139 North Walnut St., East Orange, New Jersey; W. E. Manewal, Univ. of Virginia, Charlottesville, Va.; H. F. Meier, Syracuse University, Syracuse, N.

Y.; H. G. MacMillan, Univ. of Wisconsin, Madison, Wis.; J. N. Martin, 507 Welch Av., Ames, Iowa; Edgar Nelson, Gainesville, Fla.; J. B. S. Norton, Maryland Agric. Exp. Station, College Park, Md.; P. J. O'Gara, Medford, Oregon; A. Vincent Osmun, Mass. Agric. College, Amherst, Mass.; Frederick S. Page, University of Vermont, Burlington, Vt.; A. K. Peitersen, University of Vermont, Burlington, Vt.; Fermen L. Pickett, Bloomington, Indiana; J. M. Reade, University of Georgia, Athens, Georgia; J. W. Roberts, Dept. of Agric., Washington, D. C.; Winifred J. Robinson, Vassar College, Poughkeepsie, N. Y.; John Henry Schaffner, Ohio State University, Columbus, Ohio; Annie Morrill Smith (Mrs.), 78 Orange St., Brooklyn, New York; Neil Everett Stevens, Bureau of Plant Industry, Washington, D. C.; Wilmer G. Stover, Ohio State University, Columbus, O.; G. P. Van Eseltine, U. S. National Herbarium, Washington, D. C.; Arno Viehoever, Department of Agriculture, Washington, D. C.; J. R. Weir, Bureau of Plant Industry, Washington, D. C.; John Minton Westgate, Department of Agriculture, Washington, D. C.; R. B. Whitney, Institute of Industrial Research, Washington, D. C.; Yungyen Young, University of Illinois, Urbana, Ill.; John A. Stevenson, Estacion Insular, Rio Piedras, Porto Rico.

The following members were elected Fellows: Frank M. Andrews, LeRoy Abrams, Carleton R. Ball, Joseph S. Caldwell, G. N. Collins, Arthur J. Eames, Theodore C. Frye, Leonard L. Harter, Charles F. Hottes, Lewis Knudson, Wanda M. Pfeiffer, S. B. Parish, Frederick J. Pritchard, J. B. Rorer, Charles A. Shull, Edmund W. Sinnott, Laetitia M. Snow, William C. Stevens, U. E. Safford, Walter P. Thompson, Reinhardt Thiessen, James M. Van Hook.

On the afternoon of December 30 a symposium on "The Genetic Relationship of Organisms" was held. The subject was considered under the following heads:

1. "Morphology as a Factor in Determining Genetic Relationships." Dr. J. M. Greenman, Missouri Botanical Garden.

Discussion led by Dr. A. S. Hitchcock, Department of Agriculture.

2. "The Genetic Relationship of Parasites." Dr. F. D. Kern, Pennsylvania State College.

Discussion led by Dr. C. L. Shear, U. S. Department of Agriculture.

3. "The Experimental Study of Genetic Relationship." Dr. H. H. Bartlett, U. S. Department of Agriculture.

Discussion led by Dr. B. M. Davis, University of Pennsylvania.

The address of retiring President D. H. Campbell, on "Present Tendencies in Botanical Work in America," was delivered at the dinner for all botanists on the evening of December 30.

An Endophytic Endodermal Fungus in Solanum tuberosum: E. MEAD WILCOX, GEO. K. K. LINK AND FLORENCE A. MCCORMICK.

A preliminary account of an endophytic fungus in *Solanum tuberosum*. This fungus is found throughout the whole plant but is confined to the endodermis, and, in the usual vegetative propagation of the potato proceeds from the tuber through the shoots to the daughter tubers. A discussion of its possible relation to tuberization is included.

Report on Cultures with Foliaceous Species of Peridermium on Pine Made in 1914: GEORGE G. HEDGCOCK AND WM. H. LONG.

This paper gives a summary of an extensive series of experiments with six of the foliicolous species of *Peridermium* on pines of the United States, viz., *Peridermium acicolum* Underw. & Earle, *P. carneum* (Bosc.) Seym. & Earle, *P. delicatulum* Arth. & Kern, *P. inconspicuum* Long, *P. intermedium* Arth. & Kern, and *P. montanum* Arth. & Kern. A total of 712 inoculations were made with these species and the species of *Coleosporium*, of which these *Peridermia* are alternate forms. The results of the experiments are revolutionary, since they indicate that at least four of these species of *Peridermium* and the related species of *Coleosporium* belong to one polymorphic species, and that the transfer from one herbaceous host to another is accomplished through the aecial forms in the pines.

Origin and Development of the Lamellae in Coprinus comatus, atramentarius and micaceus: GEORGE F. ATKINSON.

The origin and development of the lamellae is described and compared with the two types already known in Agaricus and Amanitopsis.

The Specific Identity of Phallus impudicus and Dictyophora duplicata: GEO. F. ATKINSON.

The only differential character between these two species is the possession of an indusium by the latter. The indusium varies in strength of development. Sometimes it is strongly developed, sometimes very weakly so, sometimes wanting or only a fundament of it in the embryonic stage.

The Relationship of Endothia parasitica and Related Species to the Tannin Content of the Host Plants: MEL. T. COOK AND GUY WEST WILSON.

Endothia parasitica (American and Chinese strains), *E. radicalis* and *E. radicalis mississippiensis* were grown on a culture medium to which had been added different percentages of commercial tannin and special extracts prepared by Mr. George A. Kerr. Extract "1-X" was soluble in water; "2-X" in water and alcohol; both were tannins, and the second between 95 and 100 per cent. pure. A third extract, "3-X," contained the coloring matter which is usually estimated as tannin. The results of the experiments indicate (1) that commercial tannins are variable and probably not pure tannin; (2) that ordinary commercial tannin and pure tannin extracts are not the same; (3) that we do not know the form or quantity of tannin or tannin-like substances with which the fungus comes in contact in the host plant; (4) that the food supply influences the vigor of the fungus and its power of resistance; (5) that high percentages of tannin usually cause a retardation of germination, frequently followed by an abnormal growth of aerial mycelium; (6) *E. radicalis mississippiensis* was most resistant, *E. parasitica* second and *E. radicalis* third; (7) that the American strain of *E. parasitica* was more resistant than the Chinese strain; (8) *E. parasitica* may feed to some extent on the tannin; (9) specially prepared pure tannin extracts were less toxic than commercial tannin; (10) coloring materials which are usually estimated as tannins were toxic; (11) tannic acid is toxic to many parasitic fungi, but there are other compounds associated with it which are more toxic and which may be more important in the economy of the host plant.

A New North American Endophyllum: J. C. ARTHUR AND F. D. FROMME.

The supposed aeciospores of *Aecidium tuberculatum* Ellis & Kellerm. were found to produce promycelia and basidiospores when germinated on the surface of water or of a non-nutrient agar or gelatine. They are, therefore, to be considered teliospores of the same character as those present in the genera *Endophyllum* and *Gymnoconia*. The morphological features of this species, especially the cupulate, bullate sorus and the presence of a peridium, together with the habit of perennating in the host are characteristic of the genus *Endophyllum*.

The fungus occurs on species of *Callirhoe, Sidalcea* and *Althaea* in Kansas, Nebraska, Colorado and Wyoming.

This is the first North American rust whose assignment to the genus *Endophyllum* has been proved by germination tests.

How to Use Aecium and Similar Terms: J. C. ARTHUR.

The terms pycnium, aecium, uredinium and telium and their derivatives were introduced into the terminology of mycology by the writer in 1905. These terms were intended to meet certain definite requirements, and not as simplified forms of terms in common use. They have been accepted by many writers, either wholly or in part, and have been accorded a place in recent large dictionaries. The present paper is intended to point out the application of the terms, and to show wherein some extension of the terms has developed which impairs their value and is likely to lead to confusion of ideas.

Cultures of Uredineae in 1912, 1913 and 1914: J. C. ARTHUR.

The present report continues a series extending over sixteen consecutive years on the results obtained from protected cultures of various species of rusts. Out of the very large number of trials made during the three years covered by the report, about seventy were successful in producing infection, involving about thirty species. Probably half the successful cultures do little more than confirm previous work with the same species. A large part of the remainder, however, extend our knowledge of the species considerably. Some show that what have been considered valid species, *e. g., Puccinia tosta, P. vulpinoidea* and *P. Dulichii*, are to be reduced to synonymy. A few cultures demonstrated the full life history of species never before cultured.

The North American Species of Allodus: C. R. ORTON.

The genus *Allodus* of the Uredinales was founded by Arthur in 1906 and embraces those species of the genus *Puccinia* auct. which have only pycnia, aecia (aecidium type) and telia in their life cycle. The present study has been made almost entirely from the taxonomic standpoint and shows in North America about forty-eight species.

Diagnostic descriptions and a key to the species are included, together with discussions and notes of interest to investigators in this class of fungi.

Foreign species have been carefully compared, but are not included in the present paper.

Correlated species of rusts in the genera *Dicaeoma, Dasyspora* and *Uromycopsis* have been enumerated so far as time has permitted, and show some interesting genetic relationships.

North American Rusts with Caeoma-like Sori: C. A. LUDWIG.

This paper takes up a discussion of the caeoma-like stage in the life history of certain North American rusts. A caeoma is understood to be a structure in which the spores are catenulate and the sorus is not delimited by peridium, paraphyses, or similar means for preventing true coalescence of sori. The material thus included is divided into five groups represented by the genera *Coleosporium, Melampsora, Neoravenelia, Gymnoconia* and *Eriosporangium* (in part). An attempt is made to arrange the species of *Coleosporium* chiefly according to their morphological characters with a view to the ultimate combination of some of them, since it seems likely that there are "more species of *Coleosporium* in the books than in nature." In the *Melampsora* group one new combination is made and one new species described. In the genus *Eriosporangium* the species *E. Hyptidis* (M. A. Curt.) Arth. is shown to have a distribution limited to the United States instead of extending to the West Indies and Central America, as heretofore considered.

The Penicillium Group—Verticillatae of Wehmer: CHARLES THOM.

A series of strains of *Penicillium* beginning with the ascugerous form of *P. luteum* and ending with *P. purpurogenum* are linked into a series by certain common characters. The conidiophore produces a single whorl of fertile branches (metulae). Wehmer uses this character to name a section, Verticillatae, of the genus. Each branch bears a verticil of sterigmata or conidia-bearing cells, closely parallel, enlarging from the base upward 5–8 microns, then tapering to form a lanceolate point ending in a conidium-producing tube, with a total length from 12 to 15 microns. The conidia in the series are elliptical, or more or less fusiform, rarely approach to globose, smooth or slightly rough, with a majority of spores in each culture, showing a size typical of the strain, while some vary widely enough to approach the range of size found in the group 2 to 3 by 2.5–4 microns. In colony character, the surface mycelium shows yellow granules which in some become reddish with age and changed reactions. The amount of yellow depends (1) upon the amount of surface growth, hence becomes abundant if the colony is floccose or is very slight in strains with short, separate conidiophores; (2) in the quantity of green conidia produced thus *P. luteum* shows only a trace of green and *P. purpurogenum* only a trace of yellow.

The species at the *P. luteum* end of the series produce orange shades in substrata containing sugars with only partial, or slow, transformation to red. *P. purpurogenum* and its close allies produce only traces of this orange color, but an abundance of a rich red coloring matter. Cultures will be shown to illustrate these points.

Spermatia of the Higher Ascomycetes: B. B. HIGGINS.

While studying the life cycle of some fungous parasites during the last two years, spermatia have been found in some twenty species. In all cases studied they develop late in the fall simultaneous with the development of young stages of the ascocarp and, in at least eleven species, with carpogonial structures.

These twenty species are scattered through four orders of the Ascomycetes, viz., *Phacidiales, Perisporiales, Dothidiales* and *Sphaeriales,* which indicates that spermatia are of quite general occurrence and may have an important bearing on the classification and relationships of the group.

The Papulospora Question as Related to Ascobolus: B. O. DODGE.

Species of fungi producing so-called *Urocystis*-like spores, papulospores, are found in several widely separated groups. Many of such forms have been connected with hypocreaceous Ascomycetes.

I have found a *Papulospora* closely associated with *Ascobolus magnificus* either as a parasite or as an asexual spore form of the *Ascobolus.* If the former is the case the mycelium of the parasite is intrahyphal; if the latter be true, then the phenomenon known as "Durchwachsung" is extremely complicated in the mycelium of this *Ascobolus.*

Further recent comparisons of papulospores with those of *Urocystis* and their description as independent Hyphomycetes are quite beside the question. It is plain that they are spore bodies either of the perfect stage of the fungus with which they are associated or of a parasite upon that fungus.

The Effect of Centrifugal Force on Plants: F. M. ANDREWS.

Climatic Distribution of the Various Types of Angiosperm Leaf-Margin and Their Physiological Significance: I. W. BAILEY AND E. W. SINNOTT.

Root Habits of Desert Plants and the Reaction of Roots to Soil Temperature: W. A. CANNON.

There are three well-marked types of roots of

the desert perennials. These are in brief: (1) roots which never penetrate the ground deeply, whatever may be its character. Most cacti have roots of this kind; (2) roots which penetrate deeply and which have a few or no roots near the surface of the ground. A typical example is found in *Koeberlinia,* although *Prosopis,* also, usually has roots of this type. And, finally, (3) many plants have roots which are intermediate between these extreme forms, and which may be said to be of a generalized character. *Covillea,* and many other species, have generalized root-systems.

The absorbing roots of the superficial type, type 1, lie, for the most part, from 5 to 15 cm. beneath the surface, while the anchoring roots are usually not much over 30 cm. deep. Since most of the roots of this type are absorbing roots, it follows that most of the roots are placed close to the surface of the ground. The deeply placed roots, type 2, on the other hand, may lie from 2 m. to 5 m. and much deeper, and have few superficial absorbing roots. The generalized root-systems may occupy any horizon between immediately beneath the surface of the ground and a depth of 2 m. or over. There is apparently no differentiation into anchoring and absorbing roots in class 2 and class 3.

A study of the mean maxima soil temperatures for a depth of 15 cm. and 30 cm. shows that the annual swing is from 46.5° F., in January, to 94.5° F., in July, at the shallower depth, and from 39.0° F., to 87.5° F., at the greater depth. Thus there is a difference at the beginning of the most active growing season of 7° F., in soil temperatures between a depth of 15 cm. and a depth of 30 cm. The temperature decreases with depth, so that as far as the records show, at depths less than 15 cm. the maxima temperatures in midsummer are greatest.

From the striking difference in root habit and from the marked difference in soil temperatures which comes with variation in depth, it follows that, in nature, plants having root habits of so diverse a character as has been given must needs be exposed to widely different temperature conditions of the soil.

Associated with the fact last presented is the one that perennials, with different root habits, have each their characteristic reaction to soil temperatures. For example, *Prosopis,* with a deeply penetrating root-system, exhibits, so far as its roots are concerned, active growth between temperatures (less than) 15° C. and 42° C. While *Fouquieria,* with a root-system resembling very nearly that of the cacti, exhibits little root growth in soil temperature under 20° C., and the same is true of *Opuntia versicolor.* The rate of growth increases with temperature rise until an optimum is reached between 30° C. and 35° C., although growth continues to 40° C., and above.

Thus, to an extent not now known, perennials with strikingly different root types show unlike and characteristic response to soil temperatures. It is thought that the difference in temperature response, coupled with differences in soil temperature, are the definitive factors which bring about the characteristic distribution in the soil of the roots of the species studied. It is largely because of these conditions, also, that "exposures" are so important in determining the characteristic distribution of many species, especially in arid or semi-arid regions.

Effect of Temperature on Glomerella: C. W. Edgerton.

Different species or strains of the genus *Glomerella* respond differently to different temperatures. One form, the one found on bean, *Colletotrichum lindemuthianum,* is very susceptible to high temperatures, growth ceasing at about a temperature of 31° C., thus explaining why this form is not prevalent during the hot part of the summer or in warm climates. The different *Glomerella* strains fall into several classes in regard to the temperature factor. These classes are represented by such forms as *Collectotrichum lindemuthianum, Colletotrichum lagenarium,* a slow-growing form from apple, a fast-growing form from apple, and *Gloeosporium musarum.* Nearly fifty different cultures have been grown at temperatures ranging from 14° C. to 37.5° C.

The Nature of Antagonism: W. J. V. Osterhout.

As the result of his studies on permeability the writer finds it possible to predict what substances will antagonize each other in their action on living tissues. This opens the way to a general theory of antagonism.

The Chemical Dynamics of Living Protoplasm: W. J. V. Osterhout.

By means of electrical measurements it is possible to follow reactions in living protoplasm without interference with the progress of the reaction or injury to the protoplasm. It is thus possible to determine the order of the reaction and to ascertain whether the reaction is reversible. It appears in many cases that the reaction is reversible up to a certain point; beyond this it is irreversible. The reasons for this are discussed.

The Nature of Mechanical Stimulation: W. J. V. OSTERHOUT.

The chief difficulty which a theory of mechanical stimulation must meet is the production of chemical reactions by a mechanical disturbance. This difficulty is met by supposing that the mechanical disturbance breaks down semipermeable surfaces, thus allowing substances to react which were previously kept apart. Experimental evidence is brought forward in support of this view.

Studies in Plant Oxidases: G. B. REED.

1. *Evidence for the General Distribution of the Oxidases.*—Some algae which have been reported to be without oxidases were found to contain a ferment capable of activating the oxidation of a specific group of compounds.

2. *The Formation of Indophenol Granules.*—Indophenol granules were found to form in cells which had been killed by agents which do not affect oxidases, but did not form in cells killed by agents known to destroy oxidases.

3. *On the Separation of Oxidase Reactions from the Caralase Reaction.*—By subjecting colloidal platinum to active oxygen at an anode its oxidase activity towards gum guaiacum and potassium iodide was increased, while its catalase activity was decreased; and by treating with active hydrogen at a cathode the opposite effects were produced. Bright platinum after anodic oxidation has a definite oxidase action, but no catalase action. Some plant extracts were found which contained oxidases, but no catalase.

4. *An Acid-stable Oxidase.*—While the oxidases are ordinarily inhibited by a slight degree of acidity, an oxidase was obtained from pineapples and some other fruits capable of withstanding 0.1 M. HCl.

Enzymes of the Marine Algæ: A. R. DAVIS.

Continuing the work begun with *Fucus,* isolation and identification of enzymes occurring in representative marine forms of the greens, browns and reds has been carried on. The results obtained show certain differences for the different groups of algæ: carbohydrases attacking the various polysaccharides are generally distributed in the greens and reds; when present in the browns they are much less active, and in a few genera have not yet been detected with the methods used. Compared with potato leaf tissue prepared in the same way, the carbohydrase activity of *Ulva lactuca,* the most active form studied, was about half.

Proteinases acting upon albumin, legumin and peptone in neutral and alkaline solution were isolated from the majority of the forms worked with and, as was true for the carbohydrases, were most active in certain of the greens and reds. No amidase action was observable.

With the exception of a few forms lipase was found to be very generally present, being especially active in *Chondrus* and *Desmerestis;* on the other hand, fatty esters were not acted upon.

Oxidases and peroxidases were found in but one form—*Agardhiella.* In this both were quite active, comparing favorably with potato tuber tissue. Catalases were present in all forms.

The total number of enzymes isolated was small when compared with the tissues of the higher plants, and their action decidedly slower. In general this action was greater in the greens and the reds than in the browns.

Concerning the Measurement of Diastase Activity in Plant Extracts: CHAS. O. APPLEMAN.

Several methods have been proposed for the measurement of the velocity of diastase activity in plant extracts. The procedure adopted by several investigators is based upon the determination of the amount of reducing sugar, usually calculated as maltose, produced by the action of a definite amount of extract upon an excess of soluble starch for a definite length of time at constant temperature. The Kjeldahl "law of proportionality" is sometimes observed and sometimes ignored. The general inapplicability of this method for plant extracts is very strikingly shown in the following table, which refers to the diastase activity in glycerine extracts from cold storage potatoes:

TABLE I

Date of Analysis	Increase in Milligrams of Sugar at 40° C. Per Hour Per 100 Grams of Potato Pulp: Total Reducing Sugar Calculated as Maltose	Total Sugar
November 28	17.0	3.6
December 20	24.6	3.7
January 13	81.9	3.7

Calculated on the basis of increase in total reducing sugars or maltose in the extract after incubation with soluble starch, the tubers would show a very marked increase in diastase with storage, but when calculated on basis of increase in total sugar, the diastase activity remains practically constant. The amount of sucrose in the tubers increases with cold storage. It is extracted with the diastase and is inverted at the incubation temperature, according to the law of the mass action.

Since non-reducing, hydrolyzable sugars are present in many plant tissues and are subject to wide variation in the same tissue, the above described method in unmodified form is not reliable.

Electrolytic Determination of Exosmosis from the Roots of Anesthetized Plants: M. C. Merrill.

Subjecting growing plants of *Pisum sativum* to the influence of illuminating gas and ether vapor causes a marked exosmosis from the roots. The plants were grown for several days in full nutrient solution and, after thorough rinsing of the roots, were placed in redistilled water whose specific conductivity was approximately .000002. Immediately afterward the plants were subjected for varying periods to the gas or vapor, and the effect determined by frequent measurements of the conductivity of the water as contrasted with that in which control plants were placed and also by subsequently growing fresh seedlings in the water.

The exposures were made in all cases under bell jars. Where the roots were exposed directly to the anesthetics the resulting exosmosis was more rapid than where the roots were kept in the water during the exposure. In the former case the root turgor decreased greatly, while in the latter case the tops were affected, but the roots remained normal in appearance even though the exosmosis was abundant, thus indicating a disappearance of mineral nutrients from the tops. With older plants the increased conductivity was less than with younger plants, thereby indicating greater resistance to the anesthetics.

Some Relations of Plants to Distilled Water and Certain Dilute Toxic Solutions: M. C. Merrill.

A careful determination was made of the interval during which *Pisum sativum* seedlings could grow in redistilled water and in certain toxic solutions, and then recover when later placed in full nutrient solution. The benefits to be derived from renewing the distilled water every four days, as contrasted with the condition where it was not renewed, were evidenced in most cases by better growth in the distilled water or greater recovery in the full nutrient solution. Horse beans (*Vicia faba*) were more marked than *Pisum sativum* in their behavior toward the renewal of the distilled water, those in which the distilled water was renewed showing more than double the growth. Bacterial and fungous action is undoubtedly an important factor, as demonstrated by the effect of boiling the water. The evidence indicates that there are several factors entering into the so-called harmful action of distilled water. Striking changes in the conductivity of the distilled water were found when plants were placed in it during various stages and conditions of growth.

Revegetation of Abandoned Roadways in Eastern Colorado: H. L. Shantz.

A roadway consisted of a trail formed by driving repeatedly over the short grass sod. After a few years a new road was formed at the side of the old trail. In this way many roads were formed and successively abandoned. The plant succession on these abandoned roadways consists of an early and late ruderal association followed by either the *Artemisia-Gutierrezia* association or the wire-grass association. The final stage or Grama-Buffalo grass association becomes established in from twenty to thirty years.

Is the Flora of the Prairie and Steppe of Arctic Origin?: B. Shimek.

The conclusion of the paper is opposed to the widely prevalent conception that the flora of the steppes (and incidentally of the prairies) is of Arctic origin, and that the "steppe" condition is an evidence of a colder climate. The fact that certain plants (and, even more conspicuously, certain animals), more particularly in Europe, are now found only in the far north, but formerly existed much farther south, is not regarded as evidence of a much colder earlier climate in these more southerly regions, for we probably have to deal here with remnants of a formerly widespread flora and fauna now largely restricted through man's influence.

Comparisons are made of plant lists showing distribution in both Europe and North America, and on this basis, and on the basis of structural adaptation to habitat, and habit, the conclusion is drawn that the plants of these treeless areas reached their present state under the influence of dry conditions, and that their present distribution was accomplished by advance from regions south of the glacial limit.

Growth-forms of the Flora of New York and Vicinity: Norman Taylor.

The study of climate, through the study of the vegetative response to it, involved the dividing of all vegetation into 10 or 12 different categories. Raunkiaer has called these "growth-forms," which are based on the amount and kind of protection exhibited by the growing or perennating shoots during the winter or critical season. The usefulness of the method lies in its value as a basis of comparison between different floras, different elements of the same flora, and even smaller cate-

gories of vegetation. By calculating the percentages of the growth-forms in the flora of different regions, we get the record of the vegetative response to climate, with all its infinite variation. Applying the method for the flora of the vicinity of New York, where, excluding weeds, ferns and parasites, there are 1,907 wild species, the percentages of growth-forms are as follows:

Megaphanerophytes	.52 per cent.
Mesaphanerophytes	4.03 per cent.
Microphanerophytes	7.18 per cent.
Nanophanerophytes	3.51 per cent.
Chamaephytes	5.29 per cent.
Hemicryptophytes	33.29 per cent.
Geophytes	20.23 per cent.
Helophytes and Hydrophytes	11.74 per cent.
Therophytes	13 per cent.

The percentage of geophytes is larger than that for any region yet studied, leading to the conclusion that the climate near New York is of such a nature that the development of geophytes is especially favored. Studies were also made on the northern and southern elements of the flora of New York, and on the high-mountain species of the region; the percentage of growth-forms being given for each of these groups, and for different regions of the earth's surface to compare with the local flora near New York.

The Effect of Breeding and Selection upon the Percentage of Total Alkaloids in some Species and Hybrids of the Genus Datura: FRED A. MILLER AND J. W. MEADER.

Through selection and hybridization an attempt has been made to develop a strain of stramonium which would show an increased percentage of alkaloids over that of the commercial stramonium leaf used for medicinal purposes. All selected plants have been carefully inbred. The alkaloidal assays have been made upon samples of air-dried leaves from individual plants. The species so far used are *Datura stramonium* L., *D. tatula* L. and *D. ferox* L.

On the Nature of Mutations: R. RUGGLES GATES.

Hybrids of Œnothera biennis Linnaeus and O. franciscana Bartlett in the First and Second Generations: BRADLEY MOORE DAVIS.

Among the contrasting characters of the parent species is one especially well adapted to a genetical study. In *Œnothera biennis* the papillae at the base of long hairs follow the color of the green stems; in *O. franciscana* the papillae are bright red. Hybrids of reciprocal crosses all have red papillæ, the color thus appearing as a simple dominant. Cultures of the hybrids in the second generation totaled 1,806 plants from sowings of 3,554 seed-like structures; 1,679 rosettes sent up shoots during the season, and on every one of these plants the papillæ were bright red. There was thus a failure of the color character to segregate in the F_2 in cultures containing 1,679 plants, and its behavior was not what might have been expected from Mendelian experience. However, it should be noted that of the 3,554 seed-like structures sown 1,748 failed to germinate, although seed pans were kept for 8–10 weeks. Also that 127 plants either died during the season or else, remaining as rosettes, failed to send up shoots upon which observations could be made. It is thus possible that the absence of a class of green-stemmed recessives may be associated with this high degree of seed sterility, the cause of which is as yet not known, or with the failure of some plants to mature.

In previous papers mention has been made of the fact that the F_1 hybrids of the cross *franciscana* × *biennis* in many characters were similar to *Œnothera Lamarckiana,* differing from this plant only in relatively small plus or minus expressions of these characters. The second generation of this cross, as was to have been expected, presented a wide range of forms, and among these were a number of plants with combinations of characters that appear to have fulfilled in essentials the requirements of a synthetic *Lamarckiana*-like hybrid. Further generations from these selected plants will be grown to test their further range of variation.

A detailed account of the above-considered cultures will later be published.

Inheritance of Certain Seed Characters in Corn: R. A. HARPER.

The various pigmentations of the integument, aleurone layer and endosperm are metidentical characters in Detto's sense, that is, the same in the cells as they are in the tissues or the kernel, as a whole. The pattern in the case of streaked or mottled grains is a character of the tissue, as a whole. The form of the dent kernels is a character of the kernel, as a whole, due to the nature and distribution of the starch and other elements in the tissues. The wrinkled form of the kernels of sweet corn is more nearly identical with the shrinkage of the individual cells of the endosperm. By crossing, intermediates may be obtained between any two such contrasting charac-

ters, and selection tends to develop fixity of type, though the range of variation may at first be even higher than that of the parent types.

Inheritable Variations in the Yellow Daisy (Rudbeckia hirta): ALBERT F. BLAKESLEE.

Variations in the following characters have been found in the wild yellow daisy: absence of rays and their presence in rather definite numbers from 8 to 30 and to perfectly double forms; width of rays; diameter of head from 1 to 5½ inches; color of rays from pale straw color to deep orange; relative intensity of color in inner half of ray forming a lighter or darker ring; different intensities of mahogany color at base of ray on upper side; mahogany on under side of ray; constriction of ray at tip, at middle, or at base—those constricted at tip either rolled in or rolled out to give the "cactus" type seen in *Dahlias*—those constricted at base without change in color or characterized by lighter color or by presence of black pigment on constricted areas; transformation of rays into tubes giving "quilled" type; the position of rays, bending upward, horizontal, reflexed, straight or variously twisted; the shape and size of disk; the color of disk from yellowish green through several grades of purple to almost black; vegetative characters such as height, branching, size and shape of leaf, fasciations, etc.

Evidence from the distribution of the variants in nature and from their reappearance in sowings from open-pollinated heads shows that most, if not all, these variations are inherited. The basal splash of mahogany on the ray seems to be inherited as a simple Mendelian dominant. Other characters are being investigated.

Bud Variations in Coleus: A. B. STOUT.

The phenomena of bud variation in *Coleus* and the behavior of pedigreed plants of vegetative propagation illustrate, in the case of red pigmentation, most clearly the behavior of a metidentical character, and show equally well that the distribution of colors in patterns is epigenetic in nature, and is, without doubt, due to physical and chemical processes quite analogous to the Liesegang precipitation phenomena by which Gebhardt reproduced in a most striking manner certain markings that occur in the wings of butterflies.

Plants propagated vegetatively through six generations developed two types of changes: (1) fluctuations and (2) mutations. Although the different patterns which arose were remarkably constant in vegetative propagation, each exhibited further changes in the epigenetic development and distribution of the red pigmentation. The phenomena associated with the appearance and subsequent behavior of the different bud variations are quite similar to the phenomena of variation, mutation and alternative inheritance in a seed progeny of hybrid origin.

The Morphology of the Œnothera Flower: GEORGE HARRISON SHULL.

The hypanthium of *Œnothera* and other Onagraceous genera is usually described in taxonomic works as a "calyx-tube." In one of my hybrid *Œnotheras* a complete series of transitional stages was presented, connecting the normal type of flower, sessile with a long hypanthium, with pedicellate flowers wholly lacking a hypanthium. This indicates that the hypanthium is of cauline nature.

The Morphology and Systematic Position of Podomitrium: D. H. CAMPBELL.

The genus *Podomitrium* comprises two species, *P. phyllanthus* from the Australasian region, and *P. Malaccense,* which has hitherto been reported only from Singapore and New Caledonia. The writer collected the latter species in Borneo and the Philippines.

Podomitrium malaccense closely resembles in appearance a *Blythia,* and sterile plants are indistinguishable. The position of the reproductive organs of the former, in special ventral branches, at once distinguishes it from *Blythia.*

The anatomy of the thallus, as well as the form of the apical cell, is practically identical in *Podomitrium* and *Blythia.*

The antheridia in *Podomitrium* are borne on special ventral shoots. In structure, and in the scales covering them, they most nearly resemble *Mörkia* or *Calycularia.*

The archegonia are also borne in special shoots. The archegonial receptacle is very much like that of *Blythia.* The embryo is much like that of *Blythia* or *Symphyogyna,* but the basal appendage (haustorium) is somewhat less developed.

The fully developed sporophyli closely resembles that of *Blythia,* from which it differs in the more clearly marked foot, and in the presence of a overwell developed apical elaterophore. The spores, in size and surface sculpturing, are hardly distinguishable from *Blythia radiculosa.*

On the whole, *Podomitrium* seems to be more nearly related to *Blythia* than to *Melzgeria,* with which it is usually associated. This study of *Podomitrium* confirms the view that there is no certain distinction to be drawn between the families Aneuraceæ and Blythiaceæ.

Fiber Measurement Studies; Length Variations: Where They Occur and Their Relation to the Strength and Uses of Wood: ELOISE GERRY.

I. The results of the study of *one white pine* tree indicate: (These are based on the measurements made on 6,600 fibers from 66 specimens.)

1. The length of fibers varies with their position in the tree.

A. In (1) a disk from the butt (age 250 years, distance above the ground approximately two feet) and in (2) a disk near the top (about 82 feet above the ground) *the shortest fibers were found near the pith.* An increase in length was apparent from the center outward. This was somewhat irregular (slides). No constant fiber length was attained.

B. In 26 bolts, taken at about 2½ to 3 inches from the pith, at 4-foot intervals between the butt and the top of the tree, a tendency toward an increase in average fiber length was apparent for about two thirds of the height of the tree.

2. *The relation between the fiber length and the strength values of the wood was indeterminate; no direct effect dependent on length alone could be found.* The following indications were obtained, however:

A. From butt to top the S. G. and strength decreased but the average fiber length increased.

B. In some loblolly pine the late wood was about twice as strong as the early wood; the relative fiber length was as 2.69 is to 3.03 mm.

C. In Rotholz the fibers are also stronger (in compression) and shorter than those in normal wood.

That is, the shortest but at the same time the thickest-walled fibers were present in the strongest specimens.

II. The general range of variation in fiber length was not found to be greater within the species than in the individual tree.

1. Longleaf pine (*Pinus palustris*) (1,700 measurements of 15 specimens).

2. Douglas fir (*Pseudotsuga taxifolia*) (900 measurements of 5 specimens).

The longest fibers were found in the earliest springwood; the length then decreased gradually and the shortest fibers were present in the last formed layers of the ring.

III. Certain general relationships also noted:

1. The root fibers of longleaf pine and white pine were found to have a fiber length as long as or even longer than that of the trunk fibers. This may enable the pulp mill to utilize stumps obtained where land is being cleared or the chips from which resin has been extracted for a strong craft pulp.

2. In general the hardwoods or angiosperms have a shorter fiber than the softwoods or gymnosperms. All other things being equal, the strength of a pulp varies with the length of the fibers composing it.

3. The early or springwood fibers are always longer than the late or summerwood fibers. The data obtained from about 80 specimens indicated that less than one fourth of the fibers found in every hundred macerated fibers were summerwood. In two cases the summerwood fibers made up about one third of this amount; in both cases this large number of fibers was found in wood from very low down in the tree. The per cent. and character of the summerwood fibers are significant factors in determining the character of a wood to be used for pulp.

Changes in the Fruit Type of Angiosperms Coincident with the Development of the Herbaceous Habit: E. W. SINNOTT AND I. W. BAILEY.

Angiosperms with fleshy fruits are almost invariably trees, shrubs or climbing herbs. Terrestrial herbs practically always have dry fruits. Herbs seem to have been developed from woody plants in relatively recent times. It is therefore evident that with this change in habit there must have been changes in many families from a fleshy type of fruit to a dry one. This is apparently due to the fact that most frugiverous birds are reluctant to feed on the ground and that herbs have consequently been obliged to develop new methods for seed dispersal.

Some Effects of the Brown-rot Fungus upon the Composition of the Peach: LON A. HAWKINS.

This paper describes the results of several series of experiments on the effect of the brown-rot fungus upon certain carbon compounds in the peach fruit. In the experiments one half of the peach was inoculated with the fungus, while the other was retained sterile under the same moisture and temperature conditions as a control. At the end of two or three weeks the two portions were analyzed. It was found that in the rotted portion the pentosan content was practically the same as in the sound half; the acid content was increased; the amount of alcohol-insoluble substance which reduces Fehling's solution when hydrolyzed with dilute HCl was decreased; the total sugar content was decreased, while the cane sugar practically disappeared.

Senile Changes in the Leaves of Vitis vulpina and Certain other Perennial Plants: H. M. Benedict.

It has been found by an investigation extending through a period of seven years that in the leaves of *V. vulpina* and other plants there occurs evidence of senility. Similarly aged leaves of differently aged plants (age being reckoned from date of last reproduction from seed) show marked differences in the extent of veinage. The aggregates of mesophyll cells enclosed within the smallest veinlets, which may be termed vein-islets, are uniformly smaller in leaves of old plants than in leaves of young plants. In other words, leaves of old plants have a higher percentage of vascular tissue than leaves of young plants; consequently they are less efficient photosynthesizing organs, and this has been proved by experiment. A formula is presented showing the method for determining age of *Vitis vulpina* from the character of its veinage. The juvenile veinage is restored only after sexual reproduction. Finally, a theory of sexuality is proposed, based upon loss in permeability.

Influence of Certain Salts on Nodule Production in Vetch: Mr. Kno.

Calcium salts are essential for nodule production in vetch. The substitution of borium or strontium to a limited degree permits also of nodule development. The relation of balanced solution to nodule production has also been investigated.

Physiological Studies of Bacillus Radicicola of Soy Bean: J. K. Wilson.

This investigation confirms earlier work as regards the influence of nitrates on nodule production, and indicates in addition that sulfates in relatively weak concentration inhibit the process. Chlorides and phosphates stimulate nodule production, while ammonium salts are inhibitory. The significant fact was developed that while nodule development was prevented by the presence of nitrates, phosphates and ammonium salts, yet the organism retained its vitality in the presence of these salts. Whether the effect of the salt is upon the root, such as to make it resistant, or upon the organism can not yet be stated.

Direct Absorption and Assimilation of Carbohydrates by Green Plants: Lewis Knudson.

Confirming and extending the work of Laurent, Molliard and others, it has been found that a variety of plants are able to absorb and assimilate various sugars, including lactose. Plants employed are timothy, vetch, onion, radish, pea, cabbage, clover, flax and corn. Lactose has been found to be utilized by vetch, radish and onion but not by timothy. For corn the sugars in order of "preference" by the plant are glucose, levulose, cane sugar and maltose; for vetch, cane sugar, glucose, maltose and lactose. Experiments on the influence of concentration of the sugar on growth, influence of sugars in respiration and color production have also been made. A study of the influence of sugars in enzyme production is now progressing.

A Preliminary Study of the Chlorophyll Compounds of the Peach Leaf: Howard S. Reed and H. S. Stahl.

The investigations were undertaken with especial reference to the foliage of peach trees having "yellows." The chlorophyll compounds were extracted and separated by the use of inactive solvents. The diseased leaves differ from the healthy in both the quality and quantity of chlorophyll derivatives extracted. The derivatives have been identified by their color, solubility, spectra and other properties.

Among others, the following derivatives have been found in healthy peach leaves: chlorophyll *a*, chlorophyll *b*, phytorhodin, chlorophyllin, phæophytin, phæophorbide, methyl-phæophorbide, methychlorophyllid, phytochlorin, carotin and xanthophyll.

As the disease advances there is a decrease in the quantity of both chlorophyll and chlorophyll derivatives. The diminution of the green series is greater than that of the yellow-brown series.

Respiration in Apple Leaves Infected with Gymnosporangium: Howard S. Reed and C. H. Crabill.

The respiration of apple leaves has been studied with reference to the pathological effects of infection. Foliage was studied at various stages in the development of the disease, using both Ganong's respirometer and Sach's baryta methods. The diseased leaves uniformly produce more carbon-dioxide than healthy leaves in the same intervals. Various factors influence the process.

The Absorption and Excretion of Electrolytes by Lupinus albus in Dilute Simple Solutions of Nutrient Salts: R. H. True and H. H. Bartlett.[1]

[1] Office of Plant Physiological and Fermentation Investigations, Bureau of Plant Industry, U. S. Department of Agriculture.

The behavior of seedlings of *Lupinus albus* toward distilled water and toward simple solutions of salts containing ions regarded as essential to the normal nutrition of higher green plants was studied by the water culture method, the plants being kept in darkness. The stronger concentrations employed were comparable with the soil solution under conditions found in the vicinity of Washington, D. C. The absorption of ions from the solutions and the loss of ions to the solution were measured by the Wheatstone bridge in terms of change of electrical conductivity.

The plants give up their salts to distilled water at a variable rate until death ensues from exhaustion. Solutions of KH_2PO_4 and KCl act essentially like distilled water.

In K_2SO_4 and KNO_3 a slight absorption phase is seen in the most favorable concentrations resulting in a minimal net gain in electrolytes to the plant. Otherwise the results differ little from those seen in the phosphate and chlorid solutions. Sodium chloride affects permeability and growth essentially like KNO_3 and K_2SO_4.

In the most favorable concentrations, of $Mg(NO_3)_2$ and $MgSO_4$ there is a slight but clearly developed absorption phase resulting in a net gain of electrolytes to the plant. A net loss takes place in the more dilute solutions and in the greater concentrations toxic action develops.

In $Ca(NO_3)_2$ and $CaSO_4$ solutions all concentrations studied support an active absorption of electrolytes and apparently enable the plants not only to retain the salts already present, but also to make net gains from the solutions.

The Absorption and Excretion of Electrolytes by Lupinus albus in Dilute Solutions Containing Mixtures of Nutrient Salts: R. H. TRUE AND HARLEY HARRIS BARTLETT.

Seedlings of *Lupinus albus* were grown in darkness in graded solutions of pairs of nutrient salts, the higher concentrations being comparable with the soil solution. Absorption or excretion of electrolytes by the roots was measured as changes of electrical conductivity.

The results obtained show that the gain or loss of electrolytes by the plants is in cases influenced by the antagonistic action of ions.

The Transpiration Rate on Clear Days as Modified by the Daily Change in Environmental Factors: LYMAN J. BRIGGS AND H. L. SHANTZ.

The transpiration of a number of crop plants has been measured by means of automatic balances at Akron, Colorado, during the past three years. Automatic records have also been secured of the evaporation from a freely exposed water surface, the depression of the wet bulb, the intensity of the solar radiation, the air temperature and the wind velocity. The present paper compares the results of such measurements for clear days. The transpiration curves are based on a large number of measurements, and expose the normal behavior of these plants on clear days.

Relation of Transpiration to the Composition of White Pine Seedlings: GEORGE P. BURNS.

The experiments reported at the Atlanta meeting were repeated during the summer of 1914, with the addition of two beds in which the physical conditions were changed by means of one and two covers of cheesecloth. The seedlings were grown in five beds each with a different rate of transpiration.

Seeds were sown in May and the first analysis was made of seedlings gathered August 11. This analysis showed the following amounts of protein and soluble ash:

Seedlings	Protein, Per Cent.	Soluble Ash, Per Cent.
No shade	13.88	4.13
Half shade	16.44	4.41
Full shade	36.82	6.46
One cheesecloth	11.56	4.14
Two cheesecloth	12.31	4.15

This table again shows the high percentage of ash in the full shade bed where the rate of transpiration was very low.

A New Method in Lichen Taxonomy: BRUCE FINK.

The results of investigation of the Collemaceæ will be presented. The plants will be treated as fungi and a new type of lichen diagnosis will be presented. This will treat the anatomical characters of the lichen to the exclusion of those features of the algal host which have heretofore been included in the descriptions of these lichens. The characters of the cortices and medullæ have been carefully investigated, and several features will be presented which are new to lichen taxonomy. The sex organs have for the first time been studied with a view to ascertaining their value as diagnostic characters. Camera lucida drawings of cortices, medullæ, apothecia, procarps and spermagonia will be shown, and their taxonomic value will be discussed.

The Mechanism for Discharging the Eggs of Dictyota Dichotoma: W. D. HOYT.

The young eggs of *Dictyota dichotoma* are enclosed by thin walls showing no differentiation,

but as they mature their walls thicken and become differentiated into a thick inner and a thin outer layer. At the instant of discharge the inner layer swells and becomes gelatinous, the outer layer is irregularly ruptured, and the egg is forced through the opening, thus formed, sometimes to a distance of 0.24 mm. In escaping the egg is still enclosed by the gelatinous inner layer, but is soon set free by the solution of this layer.

The observed facts indicate that the force utilized in discharging the eggs is obtained solely by the swelling of the inner layer with the contraction of the stretched outer layer of the oogonium wall.

Both at Beaufort, N. C., and at Naples, about 65–75 per cent. of all the eggs of each crop were discharged within a single hour of a single day, beginning at about the time of the first observable traces of dawn.

The swelling of the inner layer of the oogonial wall, with the resultant discharge, did not occur in eggs that were killed by heat, cold or chemicals, and was practically or entirely prevented by anything that interfered with the life conditions. It could not be initiated by any means before the usual time for discharge, but, as the usual time approached, seemed slightly accelerated by transfer from a moist dish to sea water.

The above facts seem to indicate that the swelling of the inner layer of the oogonial wall is under the direct control of the protoplasm, or that it is accomplished by means of enzymes formed by the protoplasm and affected by the same conditions that affect the living substance. Of these two possibilities, the latter seems more probable.

Cell Division and the Formation of Colonies of Volvox: R. A. Harper.

The planes of the first two divisions of the mother cell of the young colony intersect at right angles. The plane of the third division lies so as to form the well-known cross figure. The factors determining this deviation from Sach's principle of rectangular intersection are associated with the surface tension developed in a plate made by successive bipartition of cells, and lead to the further incurving of the plate and formation of the globular colony.

Prochromosomes in Synapsis: C. A. Darling.

The work on prochromosomes by Rosenberg, Overton and others has suggested the possibility that some cells might be found the study of which would considerably increase our knowledge concerning the behavior of the chromosomes in synapsis and reduction. Such cells have been found in the Norway Maple *Acer platanoides*.

In the so-called resting stage of the nucleus of the pollen mother cell in this species are 26 definite bodies corresponding in number to the 26 chromosomes found in the vegetative cells at the time of division; most of these bodies, or prochromosomes, are distributed about the periphery of the nucleus, but a few are to be found lying close to or against the nucleus. Upon staining with safranin, gentian-violet and Orange G., these 26 prochromosomes are stained blue and the nucleolus red, so that the two are readily distinguished. At this stage the linin threads take the stain only sparingly. At least some of these threads appear to be attached to the prochromosomes; in some cases the threads are connected, forming a sort of net with nodes or thickenings; these nodes do not take the gentian-violet stain and are not definite bodies like the prochromosomes.

The prochromosomes are noticeably arranged in pairs; in some cases the two are separated by at least twice their own width, while in other pairs they almost touch each other; in no case do they appear to be connected. The prochromosomes vary somewhat in size, but so far as observations go the individuals of a pair appear to be equal.

As the period of synapsis approaches, the threads become more conspicuous and take the gentian-violet stain more readily; the prochromosomes still retaining their definite individuality appear to come closer together. The beginning of synapsis is indicated by the contents of the nucleus being drawn toward the nucleolus and collecting at one side of the nuclear cavity. The whole network of threads and prochromosomes becomes more or less massed; only in rare cases do any of the threads appear to lie parallel.

In complete synapsis only a few threads are distinguishable, especially those extending out from the synaptic knot. The prochromosomes, however, are still very apparent; in most pairs the members appear to be in contact with each other, although some are still separated. As growth proceeds the threads which extend outside of the knot become thicker and contain more chromatin, as shown by their staining reaction. These threads soon become double, the evidence indicating that this is due to a longitudinal splitting of a single thread rather than to the parallel arrangement of two separate threads. Apparently each of these thick threads is formed by the gradual flowing out of the contents of the prochromo-

somes on the thin threads to which they were attached before synapsis began, the contents of the two individuals of a pair flowing in opposite directions.

As the growth period advances these threads enlarge, become less entangled, and the splitting becomes more apparent. At this stage deeper staining bodies of different sizes are found distributed on the threads; these bodies, possibly chromomeres, are always found in pairs, one on each of the two parts of the double thread. There are usually 3 or 4 pairs of these chromomeres on each of the bivalent threads, the individuals of each pair being opposite each other and equal in size. As these bivalent threads become less entangled the number of the threads is found to be 13, one half the number of prochromosomes observed before synapsis. The details from this stage on have not as yet been worked out, but observations indicate that each of these 13 threads becomes shorter and finally forms a bivalent chromosome.

In the first division of the nucleus 13 chromosomes pass to each pole; in the reconstructed daughter nucleus 13 prochromosomes appear, but these are not arranged in pairs. In the resting nuclei of the somatic tissue the prochromosomes are present and appear to be more or less in pairs.

These observations seem to show that in *Acer platanoides* prochromosomes exist in the nucleus; that they are arranged more or less in pairs in both somatic and mother cells; that in synapsis the members of each pair unite and form a thick thread on the single thread which preceded synapsis; that this single thick thread becomes split longitudinally; that upon this bivalent thread occur paired chromomeres; and finally that each bivalent thread becomes a bivalent chromosome which divides into univalent chromosomes in the first division of the pollen mother cell.

Cytology of Sphæroplea: E. M. GILBERT.

Cleavage begins with constrictions from the plasma membrane, and the cell contents are cut into masses of varying sizes. A single row of large cells or a double row of smaller cells may be found in a single filament.

All eggs at first contain more than a single nucleus, and all but one of these disappears before the egg is fully mature.

Nuclear divisions as far as observed are mitotic and no indications of amitotic divisions, described by earlier investigators, have been found. There is no fragmentation of the nucleole to form the chromosomes.

The number of pyrenoids found in eggs varies from two to seven.

The pyrenoids vary greatly in size and each is made up of a varying number of segments. The starch is usually laid down around the pyrenoid in definite layers but at times the arrangement is very irregular. Stromatic starch is very abundant in some mature eggs.

The pyrenoids disappear from portions of filament which are active in the formation of sperms.

Fertilization does not take place until the egg is fully formed and rounded; at this time the egg nucleus lies in the center of the egg.

An Anatomical Study of the Root of Ipomœa batatas: FLORENCE A. MCCORMICK.

A preliminary paper on the anatomy of *Ipomœa batatas*. During the investigation, a fungus, similar to the one found in *Solanum tuberosum* has been found in the endodermis of the root, but so far the fungus has not been seen in the stem.

The Anatomy of a Protomyces Gall: ALBAN STEWART.

The lower parts of the stems of *Ambrosia trifida* L. are often attacked by *Protomyces andinus* Lagh, causing considerable disturbance in the tissues of the host. Large swellings are caused by this parasite, one or more of which may appear on the same plant.

Sections of these galls show, among other things, an increase in the tissues of the bark, an abnormal growth of the fibrovascular bundles as compared with non-infected parts close by, a broadening of the rays and the formation of other parenchyma elements in the bundles, areas of cambiform cells in the pith.

A gall caused by an unknown insect, probably of the order Lepidoptera, also occurs on the stems of this species of *Ambrosia*. The changes induced by this insect in the tissues of the host are similar in certain respects to those caused by Protomyces.

The Anatomy of the Punctatus Gall: ALBAN STEWART.

Andricus punctatus Bass., a hymenopterous insect of the family Cynipidæ, causes large woody galls on the stems and branches of *Quercus velutina* Lam. and other closely related species of oak. This gall possesses, among others, the following anatomical characters which are of especial interest.

A recapitulation of a similar condition of ray structure to that which occurs in traumatic wood

of related species of oak. Other characters which agree closely with general conditions in traumatic tissue are as follows: A vertical shortening of the broad rays. The presence of knarls which appear only in tangential sections of the gall. A parting of the fibers to right and left in the vicinity of the larval chambers. Areas of isodiametric parenchyma cells with lignified walls, and a shortening of many of the other cells of the wood. A reduction in the number or an entire lack of vessels. Absence of distinct annual rings of growth. A suggestion of a return of the cambium to its normal activities in the outermost layers of wood. Woody inclusions in the bark.

The Anatomy of a Peridermium Gall: Alban Stewart.

Large woody galls occur on the branches of the jack pine, *Pinus Banksiana* Lamb., which are caused by an infection of *Peridermium* (*Aecidium*) *cerebrum* Pk. The following anatomical differences occur in the woody portions of these galls as compared with the normal wood of this species of pine. A greatly increased production of woody tissue. An increase in the number, and a broadening of the rays both vertically and tangentially, characters which also appear in traumatic wood of this species. The presence of knarls in tangential sections. A greatly increased production of resin canals in the gall, but no such increase in the normal wood close by. A shortening of many of the tracheids as well as blunt end walls and wavy side walls of the same. Cells which partake of the character of both tracheids and parenchyma cells in their pitting. Alternate as well as opposite arrangement of pits in the walls of the tracheids. Apparently an absence of bars of *Sanio* from the walls of the tracheids in many instances.

A Note on the Leaf Anatomy of Avicennia: Alban Stewart.

On the Forms of Castela galapageia Hook. f.: Alban Stewart.

Photographing Mosses: A. J. Grout.

When beginning the study of mosses I found identifications very difficult because of the lack of suitable and adequate literature and illustrations. I did not have access to Sullivant's "Icones" or the "Bryologia Europæa."

When as an advanced student I had access to these works I formed the ambition to put similar but cheap and simplified books within the reach of any enterprising student. My desire was to make new moss students instead of new moss species, because what we need to advance bryology in America is, first of all, more observers and collectors.

The two books I have published were illustrated by drawings, many of which were taken from the standard works mentioned above. But I saw how valuable photographs were in the study of flowers, ferns, etc., and I became ambitious to equal this work in the mosses and hepatics. To this end I have devoted my spare time for the past year or two, and I have succeeded in enlisting others. Professor Holzinger has done some excellent work.

My outfit is a Bausch and Lomb camera for micro-photography with a heavy iron base and long bellows. Instead of the cap to fit over the eye-piece of the compound microscope I put in a lens-board or boards. I have a battery of three lenses, a Wollensack Anastigmatic F. 6.8 for a 4 by 5 camera and a supplementery lens to shorten the focus. A Beck Neostigmar 3 in focus, f. 3.5, wide angle from a motion-picture camera and a Bausch and Lomb wide angle Zeiss-protar, focal length $2\frac{3}{4}$ inches.

The Wollensack and supplement give magnifications up to 5 diameters, and the automatic shutter makes it more convenient than the others, which have to be uncapped. Also it gives plenty of illumination for focusing. The Beck gives magnifications up to 7 diameters and also admits plenty of light for focusing. The Zeiss protar is so small that focusing is difficult unless bright sunlight shines on the object, but I can get 9 diameters. To get depth the lenses were stopped down to 32, 64 or even to 128 U. S., and in strong light were given from 3 min. at 32 U. S. to 6–8 min. at U. S. 64 when cloudy bright and indoors.

If the mosses were not dry the setae would sometimes twist during the longer exposures so as to produce a bad blur. I have had better results with reflected light than transmitted light. I am undecided as to whether a black background is superior to a white or not. Against the black background every speck of dust magnified tenfold produces a disagreeable effect.

I have also tried peristomes by transmitted light under a compound microscope. I squandered more than a dozen plates on the peristome of *Ceratodon*, but its dark red color and density foiled my attempts to get anything but a silhouette.

The photographs themselves will tell you far more than I can as to my results.

George T. Moore,
Secretary